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ONTARIO

Department of Education

COURSES OF STUDY

GRADES IX, X, XI, AND XII

INDUSTRIAL ARTS AND CRAFTS
GENERAL SHOP

Revised Courses introduced September, 1946

Issued by Authority of
The Minister of Education

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INDUSTRIAL ARTS AND CRAFTS

Aims

1. To develop mechanical intelligence and skills in the child and to broaden his knowledge and appreciation of farm, home and industrial situations.

2. To develop the child physically through handwork and also to develop healthy habits and attitudes toward work which will help him to become a more intelligent producer or consumer of industrial products.

3. To inculcate in the child an appreciation of good design and craftsmanship which embraces the development of self-satisfaction in his ability to do things well.

Divisions

The Industrial Arts and Crafts Course is divided into two main sections, as follows:

Section I. "General"—suggested for urban communities.

Section II. "Home and Farm Mechanics"—suggested for small urban and rural areas.

However, should a combination of options from Section I and Section II be desired by a Board, to meet local conditions, these may be selected, subject to the approval of the Minister.

Drafting is obligatory in any course elected. This subject must be supplemented by three options chosen from the sections outlined above.

General Suggestions

1. A suitable selection of topics shall be made to form the prescribed Course of Study.

2. The project shall be the usual medium for the presentation of shop instruction, but should not be overdone for show purposes at the expense of the skills intended for that particular grade.

3. The plan of the General Shop necessitates simultaneous instruction in a number of varied activities. Shop libraries, illustrative materials and other lesson aids, carefully organized to direct pupil effort, will be found of valuable assistance in the carrying on of instruction and the general administration of the shop. Tools and other equipment should be properly stored in cabinets provided for the purpose and made readily accessible to the pupils, as required. Each job or operation performed by the student should be appraised and recorded promptly by the instructor.

4. In view of the importance of organization and the necessity for maintenance of supplies and equipment the instructor should be allotted extra time during the school day for this purpose.

5. Dangerous conditions affecting the health and safety of the pupils must be avoided. Exhaust gases from running engines and fumes from heat-treating processes, and the like, must be effectively discharged. All machines must be properly guarded; safety instruction must be given wherever hazards exist; and a first-aid cabinet must be readily accessible. A clean and well-appointed shop with equipment maintained in first-class operating condition is an important factor in the prevention of accidents.

6. It is the duty of the instructor to train the students in good shop habits (such as sweeping down benches, keeping tools and cupboards in condition, etc.), but it is not his duty to perform such janitor services as cleaning floors, windows or dusting the shop.

SECTION I

DRAFTING

Grade IX

1. Blueprint Reading:

   Interpreting simple blueprints of familiar objects and shop projects, using orthographic, isometric and oblique (cabinet) projection.

2. Working Drawings:
   - (a) Simple freehand sketching of working drawings to illustrate the correct placement and projection of views.
   - (b) Two- and three-view working drawings to full size, of
     - (1) Simple rectangular objects.
     - (2) Angular objects formed of straight lines, such as wedges, hexagonal or octagonal objects.
     - (3) Circular or semi-circular objects, requiring the locating and dimensioning of circular openings and holes.
   - (c) Dimensioning.
   - (d) Sectional views; methods of indicating the section and the materials.
   - (e) Geometrical constructions as required.

3. Lines:

   The purpose and characteristics of the outline, hidden outline, centre line, construction line, extension line, dimension line and arrowhead.

4. Lettering:

   Single stroke freehand alphabet; figures and fractions; size, slant and spacing; horizontal and slant guide lines. Application in notes and dimensions.

DRAFTING

Grade X

1. Machine Drawings:

   Working drawings of simple mechanical objects or tools involving conventional indications, threads, tapped holes, countersunk holes, sections and half-sections.

2. Assembly Drawings:

   Assembly drawings to various scales of objects composed of several parts, for which various details are given, such as a book rack, table, cabinet or other shop project.

3. Geometrical Construction:

   The construction of regular figures, arcs, tangents, curves, fillets, with the drafting instruments to be introduced as required in the drafting projects.

4. Development of Surfaces:
    - (a) Parallel line and radial line methods for layout of patterns—
        - (1) Rectangular objects such as a metal box or dust pan.
        - (2) Cylindrical objects such as a right cylinder, an oblique cut cylinder, two-piece elbow, scoop.
        - (3) Conical objects such as funnel, fruit jar filler.
    - (b) Allowances for laps and seams on patterns.

DRAFTING

Grade XI

1. Machine Drawing:
    - (a) Detail and assembly drawings of machine parts or tools such as babbitted bearing, screw jack, and drill vise, which require more difficult placement and projection of views, auxiliary views and sectional views.
    - (b) The use of catalogues, handbooks and reference books for details of machine parts, fastenings and fittings.
    - (c) Layout of pipe lines, calculation of lengths, selection of pipe fittings.
2. Building Construction:
    - (a) The drafting conventions more commonly used for indicating details of building construction; symbols for electrical work, plumbing and drains.
    - (b) Floor plan layout and scale drawing of simple structure such as cottage or a farm building.
    - (c) Simple sketching and layout plans indicating the use of building materials commonly employed in the community.
3. Landscape Drawing:

    Map-making to scale such as a layout for a garden, farm or park.

DRAFTING

Grade XII

1. Machine Drawings as related to other options:
    - (a) Detail drawings of machine parts or simple mechanical equipment from notes and sketches prepared by examining and measuring the actual objects. The drawings should indicate machine operations and materials, and give all dimensions and data necessary for duplicating the part.
    - (b) Assembly and detail working drawings of mechanical devices or tools such as pulley transmission, flanged coupling, stuffing box, pump parts or simple machines; standard fastenings, machine bolts, cap screws, set screws, keys and key seats.
    - (c) Inking, tracing and blueprinting.

2. Building Construction:
    - (a) Drawings for a simple one-storey frame building such as a garage, hog pen, chicken pen, farm work shop or summer cottage.
    - (b) Detail drawings for carpentry work such as door and window frames, roof framing, cupboards, work benches, stairs.
    - (c) Bill of material: listing quantities and compiling order forms for materials required to fabricate the objects shown on the working drawings.
3. Isometric Drawing:

    Principles of drawing straight line objects and circles in isometric.
4. Development of Surface:
    - (a) Intersections: plotting the lines of intersections of cylindrical and rectangular shapes joining at various angles such as in T-pipes, branch pipes, elbows, and gutters.
    - (b) Pattern layout applying parallel line method of development to such objects as three-piece elbow and T-pipes.
    - (c) Radial line method applied to such objects as oblique cut cones ventilators, tapered containers.

APPLIED ELECTRICITY

Grade IX

Aim of the Course

That the student as a future householder will use electrical service safely and intelligently.

1. Simple Circuit—to illustrate:
    - (a) (1) A complete path—closed circuit.
        - (2) An open circuit.
        - (3) The flow of electricity is from the source back to the source.
        - (4) A short circuit—fuse protection.
    - (b) (1) Electrical pressure—the volt—voltage.
        - (2) Electrical current—rate of flow—ampere.
        - (3) Electrical res.—ohm.
        - (4) The electrical cycles—25 and 60.
2. Signal Circuits:
    - (a) Front and back door bell system.
    - (b) Two-chime system.
    - (c) Three-wire return call system.
3. Home Safety—experimental illustration to show:
    - (a) Shock hazard of grounded objects, such as bathroom fixtures, sinks and faucets, radiators, laundry equipment, etc.
    - (b) Fire hazard of defective cords, temporary wiring, etc.

(c) Elementary study of conductors and insulators (a few common metals and non-metals).

4. Wiring:
    (a) Making an extension cord or wiring a table lamp.
    (b) Making or repairing an appliance cord.

5. Economic Use of Electrical Appliances:
    (a) How to read the kilowatt-hour meter.
    (b) How to compute the domestic service bill.
    (c) Average costs of operating the common electrical appliances.

APPLIED ELECTRICITY

Grade X

1. Series and Parallel Circuits:

    Note.—Observe brilliance only—no electrical measurements necessary.

    (a) A circuit with a fixed load in which dry cells as a source of current may be added one at a time (1) in series, (2) in parallel, and the general effect on the load observed and recorded.
    (b) A circuit with a constant supply voltage and the load units added one at a time (1) in series, (2) in parallel, and the general effect observed and recorded.
    (c) A circuit with fixed voltage and fixed load having controlling devices in parallel.
    (d) A circuit with constant supply voltage, variable lamp load, each lamp having its own controlling device.

2. Surface Wiring (Knob and Tube):
    (a) Install two lights, each controlled by a surface snap switch.

    Note.—All surface equipment, no flush.

    (b) Install two lights controlled by two three-way switches.

    Note.—The related joints, namely "T" tap, end splice, and rat tail, should be included as integral parts of these projects.

3. Magnetism and Electro-magnetism:
    (a) Experiments to investigate and/or prove the elementary laws and facts concerning magnetism.
    (b) Experiments to develop the field of force about a straight conductor carrying current (right hand rule).
    (c) Basic principles of electromagnets (effect of turns, effect of current, right hand rule for polarity), developed through the making of simple electromagnets.
    (d) Structure and function of a vibrating bell.

4. Converse Relationships—experiments to show:
    (a) (1) Force exerted on a conductor carrying current in a magnetic field.
        (2) That force exerted depends upon amount of current and strength of field.

(b) (1) E.M.F. induced by relative motion between a conductor and a magnetic field.
    (2) Amount of E.M.F. induced depends upon rate of cutting the lines.

(c) That E.M.F. is generated by chemical action resulting from two dissimilar electrodes immersed in a solution.

(d) That chemical action results from current flowing through certain solutions (e.g. simple plating experiments).

(e) That heat on a junction of dissimilar metals generates an E.M.F. (e.g. simple Pyrometer).

(f) That heat results from flow of current in a conductor (use resistance wire).

5. Circuit Protection:

   The simple fuse as a device for protecting circuits and equipment; types of fuses; the safe carrying capacity of standard wires and cables used in the home.

APPLIED ELECTRICITY

Grade XI

1. Wire a one-roomed structure in non-metallic sheathed cable—include a ceiling fixture, switches and duplex receptacles.
2. Install a duplex receptacle in a "finished" wall of the structure.
3. Measure voltage in series and parallel circuits.
4. Measure current in series and parallel circuits.
5. Replace a three-heat switch.
6. Experiment to discover I in relation to $\frac{E}{R}$.
7. Experiment to discover $I = \frac{E}{R}$.
8. Experiment to apply $E = I \times R$.
9. V.A. method to measure resistance of devices.
10. Experiment to investigate voltage drop on conductors—distribution lines.
11. Gauge wires—record current carrying capacity, circular mil area and calculate diameter.
12. Investigation experiment for $P = E \times I$, $E = \frac{P}{I}$ $I = \frac{P}{E}$.
13. Experiment to investigate the action of thermal element breakers and thermostats.

APPLIED ELECTRICITY

Grade XII

1. Experiment to discover or review the elementary principles of magnetism.
2. Experiment to discover or review the elementary principles of electromagnetism.
3. Experiment to discover or review the elementary principles of electromagnetic induction.
4. Dismantle and assemble an auto generator.
5. Dismantle and assemble a split phase start induction motor.
6. Dismantle and assemble a capacitor start induction run motor.
7. Dismantle and assemble a repulsion start induction run motor.
8. Dismantle and assemble a series A.C. motor.
9. Install a single phase fractional H.P. motor with a manually operated, thermal overload protection switch. Switch installation to be in armoured cable.
10. Install a fractional H.P. motor, single phase, with magnetic switch and remote control, in armoured cable.
11. Install a 220/110-volt, three-wire service with four-branch circuit distribution.

FORGE AND VISE WORK

Grade IX

1. Equipment and Materials:

   Trade description of such tools, equipment and materials as may be required for this course.

2. The Forge Fire:

   Selection of fuels; arrangement of fuels and proper maintenance of fire; temperatures required for metal working.

3. Forge Operations:

   Heating; cutting with hot or cold set; bending, drawing, upsetting; forging a flat; punching.

4. Vise Work Operations:

   (a) Laying out; cutting with hack saw, filing; drilling (hand drill), countersinking, riveting; finishing.

   (b) Tapping and threading; tapping a through hole; relation of tap and drill sizes; precautions; use of proper cutting oil; threading with a die.

FORGE AND VISE WORK

Grade X

1. Forge Operations:
    - (a) Cutting; bending in the bending fork; drawing, upsetting; forging flats, forging round to square, forging square to round; punching.
    - (b) Heat treating:
        - (1) Workability of various metals.
        - (2) Shop tests for distinguishing metals.
        - (3) Simple hardening of steel: heating, water quenching, testing.
        - (4) Tempering: preparation of steel, recognition of colour scale, quenching, testing.
2. Vise Work Operations:
    - (a) Laying out; cutting with cold chisel, hack sawing, filing; bending, twisting; drilling, countersinking, riveting; finishing with abrasives.
    - (b) Tapping and threading:
        - (1) Tap drill sizes; national coarse and national fine threads; precautions in use of taps.
        - (2) Threading with a die, adjustment of die; pipe threads and pipe sizes.

FORGE AND VISE WORK

Grade XI

1. Forge Operations:
    - (a) Cutting; bending with the use of forms, drawing, upsetting, forging flats, punching, twisting; making and using templates for testing curves and lengths of duplicate parts.
    - (b) Brazing, welding; fastening with clips.
    - (c) Heat treating; annealing, hardening, tempering, testing, case hardening.

    NOTE.—Precautions shall be taken to avoid dangerous cyanide fumes in case-hardening operations.
2. Vise Work Operations:
    - (a) Bending with the use of forms, twisting; drilling, countersinking, riveting; filing; hammering, raising of flat surfaces.
    - (b) Cutting, bending and drilling tube material; finishing same.
    - (c) Finishing with abrasives, flat black and bronze paint.

FORGE AND VISE WORK

Grade XII

1. Forge Operations:
    - (a) Cutting; bending scrolls, drawing, upsetting, forging flats, punching, offsetting; use of templates on curves and duplicate parts;

shrinking on bands and collars; tapering round and square stock; shaping eyes and rings.

(b) Brazing, welding; fastening with clips.

(c) Forging of various tools from tool steel.

(d) Heat treatment.

(e) Moulding and casting:

(1) Simple moulding equipment; draft, shrinkage, procedure in making two-part moulds; moulds including simple vertical and horizontal cores.

(2) Simple castings of lead base white metal.

2. Vise Work Operations:

(a) Bending with the use of jigs, twisting; drilling, countersinking, riveting; filing; hammering, raising of flat surfaces.

(b) Finishing with abrasives, enamel, lacquer; hammer finishing; ornamenting.

MACHINE SHOP PRACTICE

Grade IX

1. Hand Tools and Bench Work:

Trade description and use of such tools and equipment required for this course as soft and hard hammers, chisel, punch, file, hack saw, and vise.

2. Layout Work:

(a) Coating of metal surfaces (copper sulphate, chalk) to facilitate layout.

(b) Use of steel rule, dividers, scriber, hermaphrodite caliper and punch in laying out work from blueprints or drawings.

(c) Centering work for drilling.

3. Machine Tools and Operations:

(a) Lathe: names of main parts; setting up work in machine; end facing, rough turning, shoulder turning, finish turning to size and polishing.

(b) Drill press: names of main parts; operation and maintenance; preparation of work for drilling (including marking with centre punch); use of vise for mounting work; selection and mounting of drills; use of cooling and cutting compounds.

(c) Grinder: safety precautions and use of goggles; rough grinding to remove hard skin of material; rough grinding to bring material to size.

MACHINE SHOP PRACTICE

Grade X

1. Hand Tools and Bench Work:
    - (a) Extended use of hammers, chisels, punches, files, hack saws and vise.
    - (b) Riveting, threading and tapping.
2. Layout Work:
    - (a) Preparing metal surfaces to facilitate layout.
    - (b) Use of common tools in laying out more difficult work from drawings.
3. Machine Tools and Operations:
    - (a) Lathe: various turning operations between centres and on work mounted in chuck; knurling, cutting tapers.
    - (b) Drill press: preparation of work for drilling; use of vise and V-block for mounting work; selection and mounting of drills.
    - (c) Grinder: rough grinding, grinding to size, tool grinding.

MACHINE SHOP PRACTICE

Grade XI

1. Hand Tools and Bench Work:

    More difficult operations in riveting, threading, tapping and filing to size.
2. Layout Work:

    More advanced layouts involving use of surface plate, surface gauge and micrometer.
3. Machine Tools and Operations:
    - (a) Lathe: extension of work in turning operations between centres and on work mounted in chuck; right hand, standard, V-thread cutting; external taper turning; drilling and boring; repair and upkeep of belting.
    - (b) Drill press: drilling to layout including depth; use of countersink; spot facing; drawing holes to desired location; drilling for tapping; clamping of odd-shaped work.
    - (c) Grinder: grinding of lathe tool bits and twist drills; buffing, dressing of abrasive wheel; properties, selection and use of abrasives.
    - (d) Shaper: name, function and operation of the control; safety precautions, care, cleaning and lubrication; reason for variety of speeds; relation of speed to stroke; adjust speed and stroke to suit job.

   - (e) Milling machine: function and operation of the controls; safety precautions, care, cleaning and lubrication; feeds and speeds; depth of cut related to diameter of cutter; methods of holding work—vise, clamps, angle blocks and parallels; importance of careful and correct set-up; use of arbors, spacer washers, circular cutters, slittings saws; simple milling operations; purpose and application of coolant.

4. Fasteners:

   Special uses, and practice in the use of rivets, machine screws, cap screws, stud bolts, set screws, taper pins, keys.

5. Calculations:

   Application of mathematical principles to gear ratios, speeds and feeds, tapers and threads.

MACHINE SHOP PRACTICE

Grade XII

1. Hand Tools and Bench Work:
   - (a) Use of file and scraper in production of a flat surface.
   - (b) Use of reamers.
   - (c) Machine and small tool repair.
2. Layout and Gauging:
   - (a) Use of pilot holes for large diameter drills.
   - (b) Accurate use of gauges.
3. Machine Tools and Operations:
   - (a) Lathe: spotting and drilling; cutting national standard threads; internal thread cutting; taper turning, boring tapered holes.
   - (b) Drill press: counterboring; drilling thin metal.
   - (c) Grinder: use of different abrasive wheels for rough and tool grinding; mounting of wheels; grinding tool bits and drills.
   - (d) Shaper: methods of holding work; vise fixtures; adjust tool and clapper for cutting vertical or angular cuts; shaping and grooving.
   - (e) Milling machine: speeds and feeds for machine steel, cast iron, brass, slotting, straddle milling, grooving, end milling, spot facing, keyway cutting; use of indexing head for the indexing of grooves and flats.
4. Metallurgical Work:

   An elementary study of the metals in use such as iron, steel, brass, bronze, aluminum, with regard to their structure, methods of identification, physical properties, necessary working lubricants; practice in annealing, hardening and tempering.

5. Materials:

   Trade names, processes, stock materials and sizes, approximate costs.

MOTOR MECHANICS

Grade IX

1. Chassis:
   - (a) Parts: a brief examination and study to obtain the general purpose and location of the following parts in tracing the path of power—engine, clutch, transmission, differential.
   - (b) Specifications: meaning of wheel base, steering ratio, types of spring suspension.
2. Engine:
   - (a) Parts: identify, dismantle, and assemble parts pertaining to a sectioned one-cylinder engine operating on the four-stroke cycle principle.
   - (b) Operation: events in the four-stroke cycle including reference to combustion mixtures and dangers of carbon monoxide in exhaust gases.
3. Unit Parts:
   - (a) Clutch: examination of a single-plate clutch to observe the function of the foot pedal in the operation of the clutch parts.
   - (b) Gear box: examination of simple gear box to discover general arrangement of parts for various gear shift positions and speed ratio of crankshaft to propeller shaft.
   - (c) Differential: experimental determination of the main functions of a differential unit.
   - (d) Steering: examination of one type.
   - (e) Brakes: shoes, drum, and linkages applied to one wheel.
   - (f) Ignition: a simple demonstration ignition unit planned to control one cylinder which can be operated by pupils to observe—
     - (i) primary and secondary circuits, and
     - (ii) spark produced by opening distributor contacts.

MOTOR MECHANICS

Grade X

1. The Multi-cylinder Engine:
   - (a) Pistons: study of relative position of pistons in various cylinders, relation of crank to stroke, purpose of flywheel; detail study of piston assembly including rings, pins, connecting rod and bearings.
   - (b) Valves: study and adjustment of one type of valve arrangement.
   - (c) Timing: an elementary study of ignition timing and valve timing applied to a simple engine.

(d) Lubrication system: trace oil passage through the lubrication system for the engine; examine and operate an oil pump unit; study selection of motor oils for various temperatures and conditions.

(e) Cooling system: trace water passage through the cooling system for the engine; examine parts such as water pump, thermostats, and radiator; anti-freeze solutions.

(f) Fuel system: properties of gasolene; examine and test a fuel pump, trace fuel lines; examine a simple carburetor, adjust carburetor; clean lines and strainers.

2. Chassis Parts:

   A more detailed study of the following parts: clutch, gear box, drive shaft, differential, brake, rear-axle assembly, front-axle assembly. These parts to be examined, taken down, and re-assembled.

3. General Care of the Automobile:

   Tightening, removing squeaks, general lubrication.

MOTOR MECHANICS

Grade XI

1. The Engine:
   - (a) Removing and replacing gaskets.
   - (b) Piston displacement and compression ratio.
   - (c) Removing and replacing pistons and connecting-rod assemblies.
   - (d) Checking cylinder condition for wear.
   - (e) Adjusting valves.

2. The Automotive Electrical System:
   - (a) The battery: its care and service operations.
   - (b) The starter and generator: general principles and simple service adjustments.
   - (c) The lighting system: kinds of cables and terminals; types of lamp bulbs, adjustment of head lamps.
   - (d) The ignition system: simple adjustments, such as cleaning distributor, adjusting spark plugs, servicing connecting wires.

3. Carburetion:
   - (a) Principle and construction of the single-throat carburetor.
   - (b) Cleaning and simple adjustments.

4. Transmission System:
   - (a) Dismantling and assembling a clutch.

- (b) Study of the transmission unit: tracing path of power and determining speed ratio for each shift.
- (c) Examination of a rear-axle unit.

5. Running Gear:

   The steering gear and front wheels: examination of a typical steering and linkage assembly.

MOTOR MECHANICS

Grade XII

1. The Engine:
   - (a) Making and fitting paper gaskets.
   - (b) Grinding valves (hand method).
   - (c) Adjusting valves (running engine).
   - (d) Cooling system: cleaning and flushing; replacing pump packing; fitting hose connections.
   - (e) Tuning a running engine.
2. The Automotive Electrical System:
   - (a) Simple care and service adjustments to starter, generator and battery circuits.
   - (b) Tracing and rectifying troubles on lighting circuits; installing fuses and relays.
3. The Ignition System:
   - (a) Firing orders for four- and six-cylinder engines; wiring for one firing order.
   - (b) Low and high tension circuit; purpose of coil, condenser, breaker and distributor.
   - (c) Cleaning, adjusting and replacing spark plugs; detecting faulty plugs on running engine.
4. Carburetion:
   - (a) Adjusting carburetor on running engine.
   - (b) Cleaning gas lines, bowls and strainers.
5. Transmission and Running Gear:
   - (a) Dismantle and assemble simple gear box.
   - (b) Dismantle and assemble simple rear axle.
   - (c) Adjustment of front wheel bearings.
   - (d) Adjustment of steering gear.
6. Traffic Regulations:

   A further study of the rules and regulations of The Ontario Traffic Act.

ORNAMENTAL METAL WORK

Grade IX

1. Materials:

   Copper, brass, aluminum; strap, bar and sheet iron; soft solder and fluxes. Both ferrous and non-ferrous metals to be used; a study to be made, incidental to the making of the project, of the properties of the materials, trade description, stock sizes, gauges.

2. Operations:
   - (a) Laying out: use of tools such as rule, scriber, centre punch, dividers; coating of surfaces to facilitate layout and transfer of designs to metal; care required to avoid marks.
   - (b) Cutting: use of snips, jeweller's saw, files, hack saw and cold chisel.
   - (c) Bending, twisting, scroll forming; use of bending forks and scroll forms.
   - (d) Raising shallow round, square or oval trays or dishes over wooden blocks with mallet or hammer; annealing, planishing; etching, piercing.
   - (e) Drilling: operation and care of drill press; selection and use of drills, use of cutting oils, countersinking.
   - (f) Riveting with round head and countersunk rivets; soldering and sweating; threading with taps and dies for small machine screws.
   - (g) Finishing: cleaning, polishing, lacquering, painting.

ORNAMENTAL METAL WORK AND PLASTICS

Grade X

1. Materials:
   - (a) Copper, brass, aluminum, pewter; black iron and cold rolled steel; small diameter iron pipe; soft and hard solders, and fluxes.
   - (b) Sheet plastics, clear and coloured.

2. Operations:
   - (a) The operations of Grade IX extended to include the use of needle files; the use of special stakes for forming special shapes and edges in raising operations; surface decoration by line chasing and matting, and by the application of contrasting metals soldered or riveted in place.
   - (b) Soldered and riveted butt and lap joints.
   - (c) Finishing, buffing, acid cleaning to remove scale; hammered effects; high lighting and coloured finishes.
   - (d) Introduction of simple operations in plastics such as layout scribing, cutting with jeweller's saw, fusing, shaping, polishing, applying fasteners.

ORNAMENTAL METAL WORK AND PLASTICS

Grade XI

1. Materials:
    - (a) The ferrous and non-ferrous materials in heavier gauges.
    - (b) Plastics, clear and coloured, in sheets, rods and tubes.
2. Operations:
    - (a) The operations of Grade X applied to more intricate projects.
    - (b) Brazing and welding of joints as an alternative to the use of rivets or machine screws.
    - (c) Making and using special chasing or repoussé tools; making and using sand bags and pitch blocks.
    - (d) The use of a draw plate for making wire of various shapes.
    - (e) The applications of heat to iron for making sharp bends and shaping ends.
3. Surface Decoration:

    The work of this grade to be characterized by special attention to surface ornamentation.

    - (a) Piercing, line chasing and repoussé.
    - (b) Beading, fluting and turning of edges on dishes and bowls.
    - (c) The application of simple castings in white metal or pewter sweated in place on flat work, shallow boxes or trays.
    - (d) Decorative hinges, clasps, handles.
    - (e) Combination of copper, brass or aluminum with clear or coloured plastics.
    - (f) Hammered surfaces and edges.
4. Spinning:

    Spinning of small projects requiring the use of simple chucks.
5. Plastics:
    - (a) The operations of Grade X applied to more intricate projects.
    - (b) Introduction of simple, inlaying and colour combinations.

ORNAMENTAL METAL WORK

Grade XII

1. Operations:
    - (a) The operations of Grade XI extended.
    - (b) The setting of semi-precious stones and the making of special tools as required.
2. Surface Decoration:

    The ornamentation of Grade XI extended to more elaborate projects consisting of a single piece or of a number of pieces soldered together.

3. Spinning:
   Spinning of work requiring the use of two or more chucks.

4. Plastics:
   Simple machine operations such as routing, dadoing, turning, grooving and parting.

SHEET METAL WORK

Grade IX

1. Materials:
   - (a) Galvanized sheet iron and tinned iron: common uses, advantages, stock sizes and gauges.
   - (b) Solders: common solder, composition, reasons for different alloys.
   - (c) Fluxes: purpose; common fluxes and their suitability.

2. Hand Operations and Tools:
   - (a) Laying out: use of measuring and marking tools; use of templates; making seam allowances.
   - (b) Reinforced edges: single, double and standing folds.
   - (c) Cutting: use of straight snips for cutting on straight lines; notching.
   - (d) Folding and forming: use of mallet, hammer, stakes, and grooving tools in the construction of simple rectangular objects.
   - (e) Soldering:
     - (1) Soldering iron: oxidation, tinning, design for transference of heat.
     - (2) Soldering: heating the iron, correct position of iron, use of flux and solder.

SHEET METAL WORK

Grade X

1. Hand Operations and Tools:
   - (a) The operations of Grade IX applied to rectangular and circular objects.
   - (b) Laying out: transferring dimensions from a blueprint or drawing to the sheet metal; use of indentations for locating bending lines on reverse side of material.
   - (c) Cutting: use of straight and curved snips.
   - (d) Folding and forming: use of hollow mandrel, blowhorn or improvised stakes in forming cylindrical-shaped objects.
   - (e) Joining: objects involving seams and joints such as lap seam, hooked joint, double seam, drive cleat, corner lap joints, peined seam joint, grooved joint.

(f) Soldering: tacking, application of solder to seam, penetration of solder into seam.

(g) Reinforcing edges: the wired edge.

2. Machine Tools and Operations:

   (a) Names of main parts; proper use, adjustments and precautions to be observed for the bending brake, adjustable bar folder, slip roll former, the wiring, turning and burring machine.

   (b) Operations: folding, locking, rolling, wiring, turning and burring.

3. Machine Operations:

   (a) Adjustable bar folder: types of folds (open, close and double); setting and locking gauge.

   (b) Bending brake: method of operating for bending material in the construction of simple straight-lined objects.

4. Sheet Metal Finishes:

   Methods of preparing various sheet metals to take protective or decorative coatings.

SHEET METAL WORK

Grade XI

1. Pattern Development:

   Parallel line and radial line development applied to such objects as scoops, funnels, pails, window boxes.

   Note.—All layouts to be developed to actual size.

2. Seams and Seaming Allowances:

   Various types of seams; the amount of metal to make each seam; common uses and advantages.

3. Hand Tool Operations:

   (a) Soldering: greater facility in the use of the soldering iron; sweat soldering.

   (b) Riveting: use of rivet sets and punches; weights and sizes of rivets; spacing and punching rivet holes; blind riveting, forming rivet heads.

   (c) Tinner's snips: use of straight, curved, double-cutting and scroll snips; care and sharpening of cutting blades.

   (d) Making of objects involving wire edges, hinge flaps, hasps, staples, dropped wire handles.

4. Machine Operations:

   (a) The operations of Grade X applied to more difficult construction.

   (b) The setting and adjustment of the machines to allow for gauge of material and for wired edges.

SHEET METAL WORK

Grade XII

1. Pattern Development:
    - (a) Triangulation method of development applied to irregular shapes such as rectangular flaring pans and simple transition pieces (square to round).
    - (b) An extension of the methods of developing patterns applied to objects such as two- and three-piece round and rectangular elbows, tees, flaring pans, lips on cylindrical containers, mitred joints on eavestroughing and cornice mould.
2. Hand Tool Operations:
    - (a) The operations of the previous grades applied to more advanced projects.
    - (b) Cutting and joining mitred joints.
    - (c) Assembling eavestroughing and cornice mould (to include straight and mitred joints).
3. Machine Tool Operations:
    - (a) The operations of Grade XI extended.
    - (b) Bending brake: adjusting for tension on various gauges of metal.
    - (c) Wiring machine: use of elbow edging heads.

WOODWORKING

Grade IX

The organization of the course should make provision for pupils with previous instruction in Industrial Arts and Crafts in Grades VII and VIII. The content of this course should be modified to suit the needs of the pupils and the equipment available.

1. Materials:
    - (a) Lumber: such woods as pine, basswood, whitewood, gumwood, birch, walnut and oak; recognition of these and other common woods; processing of lumber; units of measurement and stock sizes.
    - (b) Sundries:
        - (1) Glue: kinds, sources, preparation and use.
        - (2) Hardware: types and specification for common nails, wood screws, and other hardware in common use.
        - (3) Finishing materials: characteristic properties; uses and limitations of stain, shellac, wax and paints (flat, gloss and enamel).

2. Hand Tool Operations:
    - (a) Bill of material made from blueprint or drawing.
    - (b) Laying out; selection of pieces to avoid waste, cutting to a layout plan.
    - (c) Sawing: cross-cut and rip.
    - (d) Planing: surfaces, edges, ends; at an angle to the grain.
    - (e) Squaring: steps in truing to size; use of square and back saw.
    - (f) Chamfering: planing and chiselling a chamfer, stop chamfering.
    - (g) Chiselling: paring, chiselling curves, perpendicular chiselling; use of mallet.
    - (h) Shaping: use of coping saw, bow saw, spokeshave and file.
    - (i) Boring: use of various types of bits and depth gauge; boring for screws and dowels.
    - (j) Fastening: selection and use of nails, screws, glue; clamping.
    - (k) Sanding: uses of various grades of sandpaper.
    - (l) Finishing: staining, shellacking, waxing, polishing, and the care of brushes.
    - (m) Tool sharpening: whetting of plane irons and chisels.
    - (n) Proper storage of materials; fire hazards.
3. Machine Tools and Operations:

    The machines must be adequately guarded and the guards kept in place. Operations that cannot be completed with the guards in place shall not be attempted.

    - (a) Scroll saw or band saw, sawing simple scrolls.
    - (b) Drill press: boring operations, sanding.
    - (c) Lathe: faceplate turning; rough and finish turning to size; shoulder and taper turning, turning simple beads and curves; use of calipers and templates.

WOODWORKING

Grade X

1. Materials:
    - (a) Lumber: common Canadian woods, plywood, composition board, dowel rod.
    - (b) Hardware: hooks, hinges and locks of various kinds.
    - (c) Finishing materials: stains, fillers, shellac, varnish, paints.
2. Hand Tool Operations:
    - (a) Laying out, sawing, planing, squaring and truing to size, chamfering, chiselling, shaping, boring, fastening, scraping, sanding and finishing.
    - (b) Fitting hand rip and hand cross-cut saws; sharpening tools such as scrapers and auger bits.

- (c) Gluing and clamping: gluing for width; gluing and clamping frames.

3. Machine Tools and Operations:

   The machines must be adequately guarded and the guards kept in place. Operations that cannot be completed with the guards in place shall not be attempted.

   - (a) Variety saw: cross-cutting and ripping.
   - (b) Band saw: sawing curves.
   - (c) Scroll saw: sawing scrolls, piercing.
   - (d) Drill press: boring, mortising, routing.
   - (e) Jointer: jointing edges.
   - (f) Lathe: rough and finish turning to size, shoulder and taper turning; turning more elaborate curves; larger faceplate work.
   - (g) Grinder: grinding chisels, plane irons and lathe tools.

4. Home Mechanics:

   The fundamental principles of woodworking applied to hanging doors, fitting locks, fitting window sash, glazing windows, and other similar jobs about the home.

5. Finishing:

   Staining, filling, shellacking, varnishing; use of paints and enamels.

WOODWORKING

Grade XI

1. Materials:
   - (a) Lumber: common Canadian woods, plywood, composition board.
   - (b) Trimmings: bakelite fittings, compo carvings, transfers.
   - (c) Hardware: hinges, locks and catches of various kinds.
2. Hand Tool Operations:
   - (a) More difficult operations, such as sawing tenons and dovetails, shaping mouldings or band-sawn legs, scraping hard woods.
   - (b) Joints: stopped dado, mortise and tenon, dovetail, coped joint.
   - (c) Cabinet construction: use of housed joint, glue blocking, simple panel door construction.
3. Machine Tool Operations:
   - (a) Safety precautions, care and proper operation of machine tools.
   - (b) The care, adjustment, and fitting of all attachments to the machines.
   - (c) Variety saw: cutting grooves, dados, mitres.
   - (d) Band saw: sawing curves.
   - (e) Scroll saw: sawing curves, inlaying.

- (f) Drill press: boring operations, cutting mortises, simple shaping and routing.
- (g) Jointer: surfacing, jointing edges, cutting rabbets.
- (h) Lathe: turning matched parts as legs, pairs of candlesticks; turning ornaments, knobs; turning glued-up work.
- (i) Drum and disc sanding operations on the lathe when there is no special machine available.

4. Wood Finishing:
    - (a) The use and care of finishing materials, particularly of brushes.
    - (b) More advanced knowledge of water and oil stains; mixing of fillers; use of shellac, varnish, and lacquer.
    - (c) Rubbing and polishing; the refinishing of used furniture.

NOTE.—If desired, the woodworking courses in Grades XI and XII may be organized to provide more emphasis upon building construction.

WOODWORKING

Grade XII

1. Materials:
    - (a) The materials of Grade XI extended.
    - (b) Imported woods; veneers.
2. Hand Tool Operations:
    - (a) The hand operations of the previous grades applied to more difficult projects made up of several pieces.
    - (b) Surface decoration: mouldings, simple carving, veining, inlaying, simple veneering.
    - (c) The care and sharpening of all hand tools.
    - (d) Upholstery: upholstered seat or stool.
3. Machine Tool Operations:
    - (a) Squaring stock by machine methods.
    - (b) Production methods using special tools and jigs:
        - (1) Band saw and scroll saw: compound sawing, pad sawing, pattern sawing, resawing.
        - (2) Drill press: plug and dowel cutter, spur bits, rosette cutters, pattern routing, pattern sanding.
        - (3) Circular saw: cutting tenons with the tenoning attachment; use of the moulding head and dado head.
4. Pattern-making:

    Simple solid, split and cored patterns.
5. Finishing:

    The operations of Grade XI continued to provide for greater skill in the use and a more extended knowledge of finishing materials.

SECTION II

FARM MECHANICS DRAFTING

Grade IX

1. Blueprint Reading and Sketching:
    - (a) Reading pictorial drawings.
    - (b) Development of need of orthographic drawing from pictorial drawing.
    - (c) Exercises in sketching:
        - (1) Orthographic from pictorial.
        - (2) Pictorial from object.
        - (3) Orthographic from object.
    - (d) Completion exercises of (1) missing lines, (2) missing views.
    - (e) Comparison or matching exercises.
    - (f) Reading blueprints to introduce (1) types of lines, (2) dimensioning, (3) lettering, (4) methods of indicating diameters, radii, angles, sections, etc.
    - (g) More advanced completion exercises incorporating above features.
    - (h) Making bills of material from blueprints.
    - (i) Making a few simple orthographic drawings.

FARM MECHANICS DRAFTING

Grade X

1. Blueprint Reading.
2. Advanced Exercises in Sketching:
    - (1) Orthographic from pictorial.
    - (2) Pictorial from object.
    - (3) Orthographic from object.
    - (4) Pictorial from orthographic.
3. Orthographic Drawing:
    - (a) Assembly drawing and simple sectioning.
    - (b) Detail drawing.
    - (c) Detail assembly drawing.
    - (d) Scale drawing.
4. Development of Surfaces:
    - (a) Parallel line and radial line methods of layout of patterns.
    - (b) Allowance for laps and seams.

FARM MECHANICS DRAFTING

Grade XI

1. Blueprint Reading:

   Making bills of material from advanced blueprints such as (1) lengths of pipe, number and types of fittings, and pieces of equipment in a water or gas system; (2) equipment made in the home workshop.

2. Sketching:
   - (a) Advanced isometric.
   - (b) Detail and assembly sketches of machine parts or tools such as babbited bearing, screw jack, or drill vise which require more difficult placement and projection of views, auxiliary views and sectional views.

3. Building Construction:
   - (a) Floor plan of summer house, barn or garage.
   - (b) Floor plan and elevation using proper symbols.
   - (c) Placement of equipment—in such places as farm workshop, kitchen or bathroom.

4. Tracing, Inking and Blueprinting of Any Drawing Made.

5. Landscape Drawing:

   Introduced to correlate with the Landscape Gardening of Agricultural Science, Grade XI.

FARM MECHANICS DRAFTING

Grade XII

1. Blueprint Reading:

   Bill of material listing quantities and compiling order forms for the materials required to build a garage, a small summer cottage or a brooder house.

2. Orthographic Projection:

   Working drawings of a project to be undertaken in another activity.

3. Development of Surfaces—as applied to sheet metal projects.

4. Building Construction:

   Details of framing construction in isometric such as foundation forms, platform type sill construction, door and window openings, corner construction.

FARM MECHANICS APPLIED ELECTRICITY

Grade IX

Aim of the Course

That the student as a future householder will use electrical service safely and intelligently.

1. Simple Circuit—to illustrate:
   - (a) (1) A complete path—closed circuit.

        (2) An open circuit.
        (3) The flow of electricity is from the source back to the source.
        (4) A short circuit—fuse protection.
    (b) (1) Electrical pressure—the volt—voltage.
        (2) Electrical current—rate of flow—ampere.
        (3) Electrical res.—ohm.
        (4) The electrical cycles—25 and 60.

2. Signal Circuits:
    (a) Front and back door bell system.
    (b) Two-chime system.
    (c) Three-wire return call system.
3. Home Safety—experimental illustration to show:
    (a) Shock hazard of grounded objects, such as bathroom fixtures, sinks and faucets, radiators, laundry equipment, etc.
    (b) Fire hazard of defective cords, temporary wiring, etc.
    (c) Elementary study of conductors and insulators (a few common metals and non-metals).
4. Wiring:
    (a) Making an extension cord or wiring a table lamp.
    (b) Making or repairing an appliance cord.
5. Economic Use of Electrical Appliances:
    (a) How to read the kilowatt-hour meter.
    (b) How to compute the domestic service bill.
    (c) Average costs of operating the common electrical appliances.

FARM MECHANICS APPLIED ELECTRICITY

Grade X

1. Series and Parallel Circuits:

    Note.—Observe brilliance only—no electrical measurements necessary.

    (a) A circuit with a fixed load in which dry cells as a source of current may be added one at a time (1) in series, (2) in parallel, and the general effect on the load observed and recorded.
    (b) A circuit with a constant supply voltage and the load units added one at a time (1) in series, (2) in parallel, and the general effect observed and recorded.
    (c) A circuit with fixed voltage and fixed load having controlling devices in parallel.
    (d) A circuit with constant supply voltage, variable lamp load each lamp having its own controlling device.
2. Surface Wiring (Knob and Tube):
    (a) Install two lights, each controlled by a surface snap switch.

    Note.—All surface equipment, no flush.

(b) Install two lights controlled by two three-way switches.

NOTE.—The related joints, namely "T" tap, end splice, and rat tail, should be included as integral parts of these projects.

3. Magnetism and Electro-magnetism:
    (a) Experiments to investigate and/or prove the elementary laws and facts concerning magnetism.
    (b) Experiments to develop the field of force about a straight conductor carrying current (right hand rule).
    (c) Basic principles of electromagnets (effect of turns, effect of current, right hand rule for polarity), developed through the making of simple electromagnets.
    (d) Structure and function of a vibrating bell.

4. Converse Relationships—experiments to show:
    (a) (1) Force exerted on a conductor carrying current in a magnetic field.
        (2) That force exerted depends upon amount of current and strength of field.
    (b) (1) E.M.F. induced by relative motion between a conductor and a magnetic field.
        (2) Amount of E.M.F. induced depends upon rate of cutting the lines.
    (c) That E.M.F. is generated by chemical action resulting from two dissimilar electrodes immersed in a solution.
    (d) That chemical action results from current flowing through certain solutions (e.g. simple plating experiments).
    (e) That heat on a junction of dissimilar metals generates an E.M.F. (e.g. simple Pyrometer).
    (f) That heat results from flow of current in a conductor (use resistance wire).

5. Circuit Protection:

    The simple fuse as a device for protecting circuits and equipment; types of fuses; the safe carrying capacity of standard wires and cables used in the home.

FARM MECHANICS APPLIED ELECTRICITY

Grade XI

1. Wire a one-roomed structure in non-metallic sheathed cable—include a ceiling fixture, switches and duplex receptacles.
2. Install a duplex receptacle in a "finished" wall of the structure.
3. Measure voltage in series and parallel circuits.
4. Measure current in series and parallel circuits.

5. Replace a three-heat switch.

6. Experiment to discover I in relation to $\frac{E}{R}$.

7. Experiment to discover $I = \frac{E}{R}$.

8. Experiment to apply $E = I \times R$.

9. V.A. method to measure resistance of devices.

10. Experiment to investigate voltage drop on conductors—distribution lines.

11. Gauge wires—record current carrying capacity, circular mil area and calculate diameter.

12. Investigation experiment for $P = E \times I$, $E = \frac{P}{I}$, $I = \frac{P}{E}$.

13. Experiment to investigate the action of thermal element breakers and thermostats.

FARM MECHANICS APPLIED ELECTRICITY

Grade XII

1. Experiment to discover or review the elementary principles of magnetism.

2. Experiment to discover or review the elementary principles of electromagnetism.

3. Experiment to discover or review the elementary principles of electromagnetic induction.

4. Dismantle and assemble an auto generator.

5. Dismantle and assemble a split phase start induction motor.

6. Dismantle and assemble a capacitor start induction run motor.

7. Dismantle and assemble a repulsion start induction run motor.

8. Dismantle and assemble a series A.C. motor.

9. Install a single phase fractional H.P. motor with a manually operated, thermal overload protection switch. Switch installation to be in armoured cable.

10. Install a fractional H.P. motor, single phase, with magnetic switch and remote control, in armoured cable.

11. Install a 220/110-volt, three-wire service with four-branch circuit distribution.

FARM MECHANICS WOODWORK

Grade IX

1. Materials:

   Note.—It is understood that materials and equipment shall be taught as required.

   (a) Common Canadian woods such as basswood, pine, birch, oak, cherry, maple, cedar, fir, ash, hickory.

   (b) Imported woods such as gumwood and mahogany.

   (c) Plywood, composition boards, dowel rod.

   (d) Hardware finishings; finishing materials; glue.

2. Woodwork Mathematics:

   (a) Measuring to one-sixteenth inch.

   (b) Bill of material; stock sizes; units of measurement: (1) board feet, (2) linear measurement, (3) calculation of board measure.

   (c) Layout—least waste.

3. Hand Tool Operations:

   (a) Cutting plan.

   (b) Sawing: rip, cross, back, coping, compass.

   (c) Trueing up stock.

   (d) Chamfering: planing, chiselling, stopped chamfer.

   (e) Shaping: coping, bow saw, chiselling curves.

   (f) Spokeshave, draw knife.

   (g) Boring: to depth, counterboring.

   (h) Cabinet file and wood rasp—as applied only to irregular surfaces.

   (i) Fastening: glueing, clamping, nails, screws.

   (j) Sanding: methods, common grades and kinds of abrasives.

   (k) Tool sharpening: whetting chisels and plane irons.

   (l) Finishing: paints—gloss and enamel, staining, simple filling, shellacking, French polishing, waxing, use of transfers, care of brushes and proper storage.

   (m) Joints: cross, half-lap, butt, dowelled edge, dado, rabbet.

   (n) Machine tool operations: correct use of the following machines, with names of a few of the chief parts—wood lathe, drill press, scroll saw, band saw, shaping.

   Note.—Machines must be adequately guarded and guards kept in place.

FARM MECHANICS WOODWORK

Grade X

1. Woodwork Mathematics:

   As in Grade IX of a more difficult nature (calculating cost of projects).

2. Hand Tool Operations:

   As in Grade IX with the following extensions:

    (a) Scraping: hand and cabinet scrapers.
    (b) Mitre saw.
    (c) Joints: mitre, mortise and tenon.

3. Tool Sharpening:
   Grinding chisels, plane irons, draw knife; filing auger bits.
4. Finishing:
   As in Grade IX with addition of filling, shellacking, varnishing and French polishing.
5. Machine Tool Operation:
   As in Grade IX extended to include:
    (a) Variety saw: cross cutting, ripping, dadoing.
    (b) Jointer: jointing edges.

   NOTE.—Machines must be adequately guarded and guards must be kept in place. Operations that cannot be completed without the removal of the guard *shall* not be attempted.

FARM MECHANICS WOODWORK

Grade XI

1. Carpentry:
   Constructing a western or platform type structure, using the following members: sills, girders, headers, bridging, sub-flooring, soles, studs, corner posts, plates, openings for simple windows and doors, sheathing.
2. Machine Tools:
    (a) Mortising and routing.
    (b) Turning duplicate parts on the wood lathe.
3. Sharpening:
   Hand cross and rip saws.

FARM MECHANICS WOODWORK

Grade XII

1. Carpentry:
   Construction of platform frame continued to include: rafters, trussing and blocking, roof sheathing, roof coverings, simple window frames and door frames, installing window sash, hanging doors, non-bearing partitions, lathing, trimming, insulating.
2. Sharpening:
   Sharpening special woodworking tools.
3. Machine Tools:
    (a) Advanced turning.
    (b) Production methods on machine tools.

FARM MECHANICS METAL WORK

Grade IX

NOTE 1.—It is suggested that, in those shops equipped with sheet metal machines, instruction be given in accordance with Sheet Metal option in Section I, General Course.

NOTE 2.—It is understood that materials, tools and equipment shall be taught as required.

1. Materials, Forms, Sizes and Gauges:
   - (a) Cold rolled steel.
   - (b) Hot rolled steel.
   - (c) Tool steel.
   - (d) Cast iron.
   - (e) Sheet iron: black, galvanized, tinned.
   - (f) Aluminum.
   - (g) Copper.
   - (h) Brass.
   - (i) Solders.
   - (j) Fluxes.
   - (k) Welding rods.
   - (l) Oils: lubricating, cutting, coolant.
2. Tools:

   Care and use of: hammers, tongs, hardies, chisels, centre punch, prick punch, solid punch, files, hack saw, combination set, scriber, dividers, calipers, twist drills, countersinks, steel scale, etc.
3. Machines:
   - (a) Drill press: main parts, operation, safety precautions.
   - (b) Engine lathe: main parts, safety precautions, and the following operations:
     - (1) Turning to size.
     - (2) Shoulder turning.
     - (3) End facing.
     - (4) Filing and polishing.
     - (5) Use of universal chuck.
     - (6) Knurling.
   - (c) Power grinder: care of stones, operation, safety precautions.
4. Hand Operations:
   - (a) Layout: direct and simple template, copper sulphate, chalk and marking ink.
   - (b) Hack sawing.
   - (c) Filing.
   - (d) Stamping.
   - (e) Drilling: fractional drills.

    - (f) Reading the steel scale.
    - (g) Hand threading: taps and dies.

5. Forge:
    - (a) Fire.
    - (b) Forge operations: heating, bending, forging a flat, elementary drawing.

6. Sheet Metal Operations:
    - (a) Cutting.
    - (b) Soldering.
    - (c) Simple forming.
    - (d) Folding.
    - (e) Flat lap and corner lap joints.

FARM MECHANICS METAL WORK

Grade X

1. Welding:
    - (a) Care in setting up and shutting down equipment.
    - (b) Running a head on one-eighth-inch metal.
    - (c) Butt weld.

2. Engine Lathe:

    Operations of Grade IX continued to include:
    - (a) Knurling.
    - (b) Taper turning (compound rest method).
    - (c) Drilling in the lathe.
    - (d) Free hand form turning.

3. Hand Operations:
    - (a) Layout: direct and template.
    - (b) Marking methods to include soapstone, witness marks.
    - (c) Parallel line development.
    - (d) Chiselling: shearing, flat cutting.
    - (e) Filing.
    - (f) Drilling: letter and number sizes.

4. Forge Operations:
    - (a) Hot and cold cutting.
    - (b) Drawing: forging round to square and square to round.
    - (c) Hot and cold twisting.
    - (d) Heat treating, normalizing, hardening, tempering, annealing.

5. Sheet Metal Operations:
    - (a) Punching, rivetting, grooving, forming.
    - (b) Joints: hooked, grooved, standing.

FARM MECHANICS METAL WORK

Grade XI

1. Engine Lathe:
   Operations of Grades IX and X continued to include:
   - (a) Taper turning: tailstock offset method.
   - (b) Boring.
   - (c) Finish turning.
   - (d) Use of outside micrometer.
2. Forge Operations:
   - (a) Upsetting, punching, more difficult bending with the use of forms.
   - (b) Case hardening.
3. Sheet Metal Operations:
   - (a) Wiring an edge.
   - (b) Seams: double, drive cleat, dropped wire, handles.
   - (c) Layout: use of parallel line development.
4. Welding:
   - (a) Fusion welding (1) building up worn surfaces, (2) sheet metal.
   - (b) Brazing steel and cast iron.
   - (c) Cutting.

FARM MECHANICS METAL WORK

Grade XII

1. Engine Lathe:
   Operations of Grades IX, X and XI continued to include thread cutting.
2. Forge Operations:
   Operations of Grades IX, X and XI continued to include:
   - (a) Welding.
   - (b) Use of templates for testing curves and length of duplicate parts.
   - (c) Offsetting.
   - (d) Babbitting.
   - (e) Shrinking of bands and collars.
3. Sheet Metal:
   Operations of Grades IX, X and XI continued to include:
   - (a) Making and attaching hinges and hasps.
   - (b) Layout: use of radial line development.
4. Welding:
   - (a) Fusion welding—on heavier and lighter steel; heavier cast iron requiring preheating.
   - (b) Pipe welding.
   - (c) Silver soldering.

FARM MECHANICS

Grade IX

1. Rope Work:
    - (a) Common knots and uses: bight, over-hand and under-hand loop, over-hand knot, figure of eight, square, bowline, sheepshank, clove hitch, well pipe hitch, round turn and two half hitches, miller's knot.
    - (b) Whipping and end.
    - (c) Crowning and tucking.
    - (d) Short splice.
    - (e) Use and care of rope on the farm.
2. Glazing:

    Removing putty, priming sash, cutting glass, glazier's points, puttying.
3. Utensil Repair:

    Soldering, rivetting, commercial menders, making and replacing handles.
4. Leather Work:
    - (a) Cleaning and oiling, rivetting (two types), stitching, attaching fittings.
    - (b) Repairing leather goods.
5. Concrete Work:
    - (a) Keene cement and/or ornamental concrete.
    - (b) Small plaster repairs; plaster of Paris; use of deterrent.
6. Sharpening:

    Hoes, spades, axes.
7. Electricity:
    - (a) Fuse: purpose, overload and short.
    - (b) Shock hazard.
    - (c) Cords: (1) plain extension, (2) appliance cord.

FARM MECHANICS

Grade X

1. Rope Work:
    - (a) Long splice, eye splice, adjustable halter.
    - (b) Kinds and grades of rope.
    - (c) Pulleys and blocks.
    - (d) Wire tighteners.

2. Leather Work:
    - (a) Leather tooling and lacing.
    - (b) Belt lacing.
    - (c) Elementary shoe repair.
3. Electricity:
    - (a) Simple bell circuit.
    - (b) Care and use of storage battery.
    - (c) Repairing appliances: (1) iron, toaster, (2) replacing switches and receptacles.
4. Concrete Work:
    - (a) Aggregates, selecting and testing aggregates, proportions and mixes.
    - (b) Concrete equipment and care of same.
    - (c) Pouring concrete in prepared forms.
5. Tool Sharpening:

    Knives, mower knives, pruning hook, cultivator teeth.
6. Pipe Fitting:
    - (a) Black and galvanized iron pipe—stock sizes.
    - (b) Cutting, reaming, threading, assembling.
    - (c) Common pipe fittings.

FARM MECHANICS

Grade XI

1. Concrete Work:
    - (a) Reinforcing concrete.
    - (b) Constructing forms and pouring.
    - (c) Waterproofing methods.
2. Sharpening:

    Pruning saw, sickle, two-man cross-cut saw.
3. Pipe Fitting:
    - (a) Measuring runs and making layouts.
    - (b) Sealing joints.
4. Lock and Latch Repair:

    Installation and elementary repair of various types of locks and latches.
5. Electricity:
    - (a) Install one light switch, duplex receptacle, using romex.
    - (b) Test lamp for 110/220-volt.

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FARM MECHANICS

Grade XII

1. Concrete Work:
    - (a) The types and uses of foundations.
    - (b) Construction of foundation and pillar forms, concrete blocks and brick.
2. Sharpening:
    Scissors, shears, lawn mower, scythe.
3. Pipe Fitting:
    Experimental study of a water pressure system in home and farm buildings.
4. Home Building Repair:
    - (a) Roof repair.
    - (b) Eavestroughing repair.
    - (c) Exterior painting and whitewashing.
5. Electricity:
    - (a) Characteristics and applications of fractional horse power motors.
    - (b) Grounded, weatherproof extension cord.

FARM MACHINERY, MAINTENANCE AND REPAIR

Note.—Machines and implements of the locality are to be used as the basis for instruction for the topics and/or sub-topics.

1. Types and Adjustments of:
    - (a) Bearings:
        - (1) Plain (babbit and bronze).
        - (2) Ball (cup and cone, journal).
        - (3) Roller (straight, tapered).
    - (b) Drives:
        - (1) Belt (flat, vee).
        - (2) Chain.
        - (3) Geared.
        - (4) Direct.
    - (c) Clutches:
        - (1) Friction.
        - (2) Slip.
        - (3) Ratchet (pawl, sliding).
2. Tracing the Line of Power.
3. Lubrication:
    - (a) Grease guns: principles and operation.
    - (b) Types of oilers.
    - (c) Lubricants: grades and uses.

4. Storage of Machinery:
    - (a) Location of storage.
    - (b) Preparation for storage: cleaning, repairing, repainting, greasing.
    - (c) Preparation for use: cleaning, adjusting and lubricating (appropriate time).
5. Sharpening as Required.
6. Adjustment for Efficient Operation.
7. Other Instruction as Equipment May Require.

Suggested Treatment of Some Typical Pieces of Equipment

Mowing Machine: Adjustment of pitman, register of knife, cutter bar alignment, adjustment and repair of cutter bar parts. replacing knife sections, sharpening knife, replacing pawls, lubricating, etc.

Grain Binder: Adjustment, care and repair of canvasses, cutting mechanism, threading, binder knotter adjustments, twine tension, trip tension, twine holder tension, needle setting, knotter hook cam, knotter frame adjustment, sharpening twine knife, etc.

Pumps and Sprayers: Working principles, types, operation, uses.

Gasoline Engine: Operating principle, ignition, carburetion, lubrication, cooling, adjusting and grinding valves, horse power.

Cream Separator: Working principle, gearing, lubrication, etc.

Tractor: Operating principle of multi-cylinder engine, ignition, carburetion, cooling, lubrication. To be studied from a maintenance basis only.

Selection of implements to be studied may be made from the following or any additional implements peculiar to the community:

Grade IX

Plow: walking, two-furrow
Disc harrow
Cultivators: stiff tooth, spring tooth
Spike-tooth harrow
Fanning mill

Grade X

Seed drill: fertilizer and grass seed attachments
Mower
Hayload
Side-delivery rake
Corn planter
Potato planter
Potato digger
Tobacco planter
Tomato planter

Grades XI and XII

Pumps
Sprayers
Gasoline engine
Tractor and tractor equipment
Binder
Cream separator and milking machine
Corn harvester

Electrical Option

To be same as the one for Electrical Option of Section I—General.